

Civil Defense

Emergency Treatment of Burns in Mass Casualties

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MAJOR CATASTROPHES in the past rarely have resulted in more than a few hundred seriously burned surviving patients, and yet now in the light of new devastative factors, burn casualties in the tens of thousands must be anticipated in the event of a bombing attack upon us.

A gradual build-up of an accumulating casualty list cannot be expected. Rather, should attack come, within a few seconds the medical profession would be faced with the responsibility of caring for unprecedented numbers of severely burned civilians. Under such conditions individual therapeutic preferences must of necessity be modified by those standard procedures which would permit the maximum salvage of human lives. Even though certain acceptable methods of burn therapy as applied to small numbers of cases might yield better individual results than those to be discussed herein, nevertheless the shortage of medical personnel and of hospital facilities should preclude unrestrained therapeutic latitude.

Standardization of therapy and the "assembly line" technique may be quite distasteful to the American physician who has been taught to place a premium on individualization and the application of "custom built" principles in medical care. Ideal though this practice might be in peacetime circumstances, there are conditions of national disaster under which mortality and morbidity rates would be greatly lessened by the utilization of standard therapeutic principles. Furthermore in the usual environment of medical practice the patient for the most part remains under the care of a single physician, whereas under the complications of mass casualties a multiplicity of health personnel and a variety of professional competence would carry the therapeutic responsibility for those injured. Therapy initiated at the original medical installation would be continued along the chain of evacuation with a series of professional men and women contributing to the eventual recovery of the patient. In these circumstances the need for organization and a degree of standardization is evident. The physician obviously would have opportunity to apply good professional judgment even under the most rigid medical regimentation.

Three kinds of burns may be expected in the survivors of an atomic attack: First, flash burns developed almost instantaneously from the direct intense heat of nuclear reaction; second, burns from the spontaneous ignition of clothes due to this same direct heat; and, third, burns from the more usual causes such as burning buildings and other inflammable objects secondary either to spontaneous ignition or the blast effect with leaking gas mains or damaged electrical circuits. Although the cause of these thermal burns may vary the fundamental tissue changes and the basic principles of therapy are the same as those encountered in conventional civilian practice, depending primarily on the depth and surface area of the injury.

Heat waves created by nuclear reaction travel at the speed of light and in straight lines. Thus persons under cover at the time of the explosion should be protected from thermal burns resulting from nuclear reaction or from burning clothing. Light colored clothing affords more protection than dark, inasmuch as the latter absorbs much greater amounts of heat. This phenomenon was demonstrated in the bizarre burn patterns in the skins of the Hiroshima and Nagasaki casualties who were exposed directly to the atomic flash while wearing clothing with dark and light designs.

One of the important functions of the first aid station besides that of initial emergency medical care is that of triage. Unless good clinical judgment is applied in this matter the whole control of patient flow soon bogs down. Competent professional evaluation of the injured at forward echelons will lessen the load imposed on the evacuation system by sorting out persons with minor injuries as well as the hopelessly burned casualties and establishing an evacuation priority.

Patients with superficial burns involving less than 10 per cent of the body surface are given emergency care including mild sedation, if necessary, and instructed to report for further care on an ambulatory outpatient basis. The obviously moribund and hopeless casualties are made as comfortable as possible and then segregated in an area which will not impede patient care and evacuation. Any person with third degree burns involving 70 per cent or more of

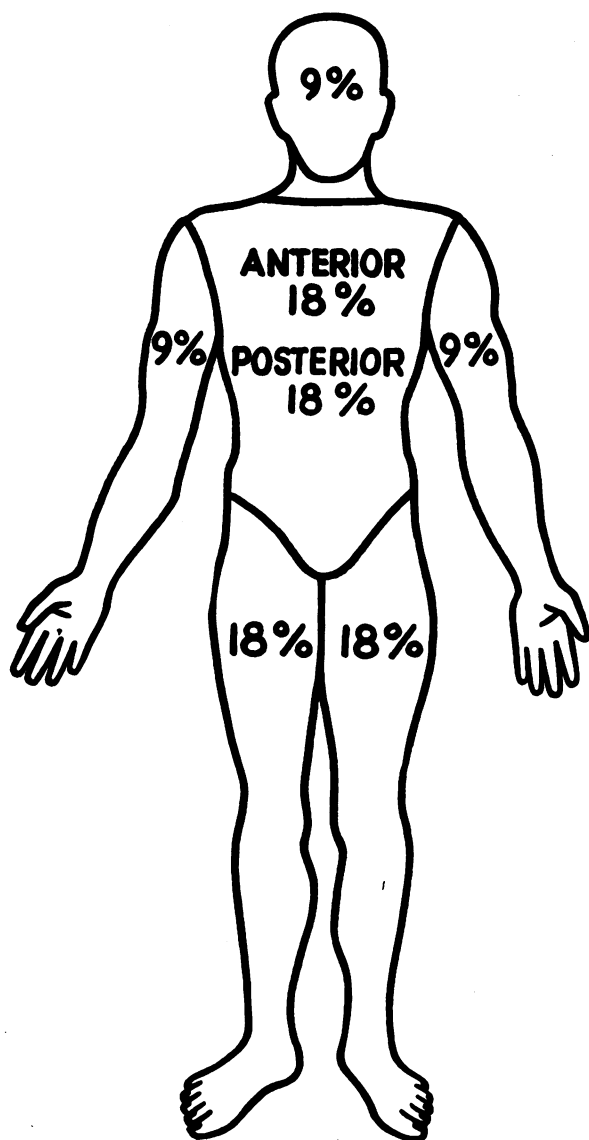


Figure 1.—“Rules of 9” for computing proportion of body surface area involved in burns.

the body surface may be considered hopelessly burned.

Activities of the first aid station are modified somewhat by the proximity and accessibility of supporting hospital facilities as well as the adequacy of medical supplies. In all events the basic treatment responsibility consists of the control of pain, protection of the wound from further contamination and the initiation of shock prevention and control. Although oversedation is to be condemned, the patient should be made comfortable. If necessary morphine sulfate is given in a 15 mg. dose. It must be remembered that poor absorption is associated with shock and repeated medication may accumulate to be released suddenly with circulatory resuscitation. Intravenous morphine will give

rapid relief in circumstances in which poor circulation retards intramuscular or subcutaneous absorption.

The standard single-piece occlusive burn dressing (described later in this paper) is applied in order to prevent contamination of the wound and to make the patient transportable. If available, antibiotic prophylactic therapy is initiated, preferably in the form of procaine penicillin G, 300,000 units fortified with crystalline penicillin G, 100,000 units in oil. It is anticipated that this dose of antibiotic soon will be available in single shot disposable units especially for first aid station and field usage. The infusion of blood, plasma or plasma expanders is commenced, depending on the particular needs of the casualty and the proximity of the supporting hospital.

Rapid evacuation to more permanent facilities is of extreme importance in the stabilization of the seriously burned patient and as soon as the casualty reaches an institution where definitive care is available a planned program of therapy is inaugurated. Segregation of burn casualties in large rooms permits greater efficiency in the utilization of medical personnel.

BURN THERAPY IN THE ACUTE PHASE

The immediate management of the severely burned patient includes two therapeutic problems: First, the prevention and treatment of burn shock; and, second, the prevention of infection. The first problem involves the intelligent appraisal of erythrocyte, fluid and electrolyte balance, while the second embraces the neutralization of the hazards of infection both by the maintenance of adequate antibiotic levels and by the protection of the injured surface from further contamination. Much more important than the local care in treating a severely burned person is the immediate management of the systemic injury.

Systemic Therapy in the Acute Phase

Though there is not complete agreement as to the accuracy and efficacy of formulas proposed for estimating fluid therapy of extensive burns, nevertheless in circumstances imposed by the necessity for treatment of large numbers of casualties by personnel not always familiar with the problems at hand such a standard approach affords a common base line from which to commence a therapeutic program.

Many methods have been used in calculating replacement therapy for the seriously burned, most of which are estimates in relation to the percentage of total body surface involved. A simple and yet fairly accurate formula for determining surface area follows the rules of nine, wherein each of the upper

extremities comprise 9 per cent of body surface, the head and neck 9 per cent, each lower extremity 18 per cent, and the anterior and posterior aspects of the combined thoracoabdominal trunk each 18 per cent (Figure 1). In small children the percentages for the extremities should be decreased and those for the head and neck increased. Any patient having a burn involving more than 20 per cent of the surface is likely to go into some degree of shock, and a burn of 40 per cent or more is considered extensive and severe.

The depth of burn damage may be rather difficult to estimate at first examination. The initial findings of first degree burns are those of erythema and edema, while the early formation of blisters denotes at least second degree burns and possibly third degree. Burns of second degree are those in which the inner layer of epithelium survives, permitting regeneration, whereas in third degree burns the entire epithelial layer is destroyed.

An acceptable standard formula for the conversion of burned body surface percentages into parenteral fluid requirements is that of Evans,⁴ which, when applied to a man weighing 70 kg. with a 35 per cent burn, calculates the first 24-hour fluid requirement as a total of 6,900 cc. broken down as follows: Whole blood, plasma or plasma expanders (70 times 35) 2,450 cc.; electrolyte solutions as Ringer's lactate or isotonic sodium chloride (70 times 35) 2,450 cc.; and 5 per cent glucose in water, 2,000 cc. In view of the dangers of water intoxication during the acute phase, one must administer the 5 per cent glucose with caution, taking into consideration such factors as the patient's size and total fluid intake. Half of the calculated amount of whole blood, plasma or plasma expander and half of the electrolyte solution and the same amount of 5 per cent glucose is given during the second 24 hours. After the first 48 hours the electrolytes of the burned patient usually can be stabilized by adequate amounts of fluid and food by mouth. One half of the fluids estimated for the first 24 hours should be given in the first eight hours and one quarter of the amount in each of the two following eight-hour periods.

Experience gained by the traumatic shock research teams in Korea showed that in using plasma expanders best results are obtained by the administration of one unit of dextran with each unit of blood. The total volume of electrolyte solutions should rarely exceed 4,000 cc. in the first 24 hours. This same limitation holds true for the total amount of blood, plasma and plasma expanders. Where it is necessary to supply large volumes of electrolyte solutions, it is advisable to utilize physiological solutions, such as Ringer's lactate, which approximate plasma in composition.

It must be remembered that no formula can supplant sound medical judgment as to the blood and electrolyte needs of the seriously burned patient. To the astute physician basic clinical observations such as the character of the pulse, depth and rate of respiration, muscle tone, skin texture and mental alertness, will contribute substantially to the determination of patient needs.

Numerous more or less complicated laboratory tests are available to determine blood chemistry variations, most of which would be impractical in an emergency of wide scope. Even certain of these tests, such as the hematocrit determination in the face of hemoconcentration, do not necessarily present the true blood picture. A very simple and yet quite accurate index reflecting fluid balance and the adequacy of therapy is the rate of urine secretion. The average sized adult secreting 50 cc. of urine every hour is considered in good fluid balance. An hourly secretion of 25 cc. denotes a minimal satisfactory output, while more than 75 cc. per hour for more than three consecutive hours indicates over-hydration. If the rapid administration of adequate amounts of fluid in the face of a low urine output produces no urinary response the possibility of renal failure is considered. In this case fluids are cautiously restricted lest pulmonary edema drown the patient.

As soon as the burned patient can tolerate fluid orally, he should have available a modified Hal-dane's solution (3 gm. of sodium chloride and 1.5 gm. of sodium bicarbonate per liter of water). An approximate and very satisfactory formula to remember is one level teaspoonful each of sodium chloride and sodium bicarbonate per quart of water. A seriously ill patient may not tolerate oral fluids the first few hours but usually will take adequate amounts during the second day. The oral administration of alkaline solutions is discontinued after the third or fourth day as soon as the electrolyte balance has been stabilized.

Moyer⁷ brought attention to the danger of water intoxication which follows the oral intake of drinking water during the early critical period. Thus during the first 48 hours, despite the patient's thirst, cracked ice, cold tap water, milk and fruit juice are denied. Fruit juices are high in potassium content and may complicate electrolyte balance if administered prior to the period of normal kidney function.

Systemic therapy during the acute phase includes prophylactic chemotherapy. Procaine penicillin G, 300,000 units fortified with crystalline penicillin G, 100,000 units in oil, is given intramuscularly every 24 hours, or aqueous penicillin G, 500,000 units intramuscularly every 12 hours. Should the oral

route be preferred or mandatory, then aureomycin, terramycin or chloramphenicol is given in doses of 500 mg. every eight hours instead of penicillin. Antibiotic therapy is discontinued after the first few days unless there is evidence of infection. If established infection is observed then, whenever facilities are available, sensitivity tests are carried out to determine specific therapy.

All burn casualties must receive prompt tetanus prophylaxis. This is even more critical when open wounds complicate the picture. If the patient has had tetanus toxoid a booster dose of 1 cc. is given. One may take for granted previous tetanus immunizations if the patient has had service with the armed forces. Those who have not had immunizations are given 3,000 units of tetanus antitoxin after the appropriate skin tests.

Local Therapy in the Acute Phase

There are two major therapeutic measures now accepted for the local care of burns each having the support of highly qualified scientists. One, known as the occlusive pressure dressing technique, is described by Allen and Koch¹ and the other is the open-air or exposure method advocated by Kyle and Wallace⁶ of Edinburgh and supported in this country by Pulaski⁸ and Blocker.² Most present-day forms of burn therapy are modifications of these two basic methods. No single therapeutic routine is applicable to all burns, for there are many modifying factors which will influence individual technique.

The exposure method lends itself best to injuries such as flash burns involving only one side of the body, burns of the face and burns of the buttocks and perineum. The advantages of the closed method are prevention of further contamination, a certain degree of splinting from the bandage, and transportability of the patient. Burns of the hand are pressure bandaged in the position of function for at least 48 hours. Involved knee and elbow joints are maintained in positions of extension and the involved extremity elevated. Old infected, granulating surfaces are always covered.

In the emergency of mass burn casualties the shortage of medical personnel and supplies may give little room for choice in the matter of preference of therapy and of necessity force utilization of the exposure technique in the vast majority of cases. Thus it is of the utmost importance that all physicians familiarize themselves with the application, advantages and disadvantages of this method of burn therapy.

The primary step in local therapy whenever possible and regardless of the specific after-care, is the removal of gross contamination with liquid detergent and copious saline solution irrigations. This is done with aseptic technique and precautions. In

extreme emergencies due to the magnitude of the number of casualties this procedure may be impossible. In such circumstances the best that can be done is to make every effort to prevent further contamination.

The Occlusive Dressing. Emergency dressings of a single-piece type have been devised by Allen and Evans under the auspices of the National Research Council for civil defense stockpiling. These are standard pads available in two dimensions of 22 inches by 18 inches and 22 inches by 36 inches, sterile packed with roller bandages of a semi-elastic consistency and safety-pin fasteners included. They are simple to apply to limb or trunk and afford a very rapid technique of burn coverage. The outer surface of this dressing is composed of water-repellent cellulose layers covering an intermediate absorbent filling and with an inner fine mesh gauze sheet which is applied directly to the unmedicated burn surface. The dressing is then secured by the enclosed roller bandage with even, firm pressure. A similar result is obtained, though with the expenditure of considerably more time and effort, by the application of fine mesh gauze layers covered in turn by mechanic's waste held in position by elastic bandages.

The burn dressings may be left in place for one to two weeks if there is no evidence of infection. Changes of dressings are made under aseptic conditions, using light anesthesia or analgesia as the case may require. Initial use of the occlusive dressing does not preclude conversion to the open-air technique of therapy. Patients may have burns dressed for transportation and then, after arrival at a suitable medical installation, be treated by the exposure method.

Exposure Therapy. After removal of gross contamination from the injured surface, patients undergoing this form of treatment are placed on sterile sheets with the burned areas exposed to the drying effects of the air. Room temperatures are maintained at an even level so that exposure causes no chilling. Usually within two or three days a thin, pliable protective crust forms which permits easy and comfortable handling of the patient. Whenever possible if the joints of the lower extremity are not involved early ambulation is encouraged. Daily inspection of the burned areas is necessary and as cracks develop in the eschar overlying joints or as liquefaction occurs along marginal areas, these are debrided and dressed with gauze in saline solution.

In the extreme pressures of emergency, seriously burned persons should be evacuated to satellite towns and segregated in hospital wards, gymnasiums or classroom halls where with the basic necessities of potable water, cooking facilities, optimum

room temperatures and freedom from insects a few physicians with adequate ancillary personnel could treat large numbers of burn casualties by the open-air method. As a word of caution, the very simplicity of the exposure method of therapy may be a danger, and, as Evans⁵ warned, "become in practice a method of surgical neglect."

BURN THERAPY OF THE SUBACUTE PHASE

Arbitrarily the subacute phase may be considered as commencing with an improvement in the status of the patient manifested by stabilization of the blood chemistry and spontaneous diuresis. In the average patient with a moderately severe burn this will be observed on the third or fourth day after injury.

Systemic Therapy in the Subacute Phase

With the appearance of diuresis and the disappearance of gastrointestinal shock, an intensive dietary program is inaugurated in order to supply the anabolic needs for tissue repair. Blocker,³ who contributed substantially to knowledge of the problem of protein catabolism in burn patients, advocated massive doses of vitamins, particularly the B complex and C, and high-caloric, high-protein forced feeding, by intragastric drip if necessary. His studies showed that burn patients enter a negative nitrogen balance with large urinary nitrogen losses which may persist for two to three weeks. Unless this is vigorously combated by adequate nutrition, tissue regeneration is retarded and resistance to infection lowered. A patient of average weight suffering from a serious burn should receive at least from 300 gm. to 400 gm. of protein per 24 hours.

Constant reevaluation of the erythrocyte content level and the administration of whole blood transfusions as indicated will correct the chronic anemia of severely burned patients. This is quite important in the overall regenerative reaction of the body systems to injury and the preparation of the burned surfaces for successful skin grafting.

The prophylactic chemotherapy initiated on the day of injury is continued for approximately seven days. After that, if infection is present, specific therapy is determined by the use of sensitivity tests.

Local Therapy in the Subacute Phase

Whether the treatment is by occlusive dressings or the exposure method the eschars over third degree burns are removed the second week and the underlying granulation tissue prepared for skin grafting by the use of saline dressings. The exposure therapy is not continued for more than three weeks even though the eschar remains intact and there is no evidence of infection. Inasmuch as the problems

of skin grafting do not fall within the scope of emergency care this particular phase of burn therapy will not be discussed.

REPORT OF A THEORETICAL CASE

A man 47 years of age was attempting a last-minute evacuation of household effects and at the time of the atomic explosion was in the open, stripped to the waist, facing ground zero. He had flash burns of the surfaces exposed to the blast.

One hour later he was treated at a mobile aid station where a one-piece occlusive dressing was applied to the anterior aspect of the trunk and similar dressings encircling each upper extremity. A hypodermic injection of 10 mg. (1/6 grain) of morphine sulfate was given as well as an intramuscular injection of procaine penicillin G, 300,000 units fortified with crystalline penicillin G, 100,000 units in oil. Due to the heavy casualty load the patient did not receive parenteral fluids.

The patient arrived by truck at Suburban Hospital, located 25 miles from ground zero, two hours later (three hours after injury). The triage team in the hospital receiving room assigned the patient to the nursing school gymnasium adjoining the hospital, this space having been designated as the hospital burn center.

Immediately on admission, because of severe pain the patient was given 10 mg. (1/6 grain) of morphine sulfate. Dextran was commenced intravenously in one forearm and Ringer's lactate solution in the other. Blood was drawn for typing and cross-matching. A self-retaining catheter was inserted into the bladder and a charting system established for the recording of hourly urine secretion and parenteral and oral fluid intake.

An hour after admission the patient was taken, with infusions running, to the improvised surgery where, under aseptic precautions, the dressings were removed and the burned surfaces cleansed of gross contamination by the use of ample saline solution irrigations. Approximately 70 per cent of the involvement was second degree in type and 10 per cent third degree. The surface areas estimated included the anterior aspect of the trunk as far inferior as the umbilicus (13 per cent), and the anterolateral portions of both arms (3 per cent), the dorsum of both forearms and hands (4 per cent), and the face and portions of the anterior surface of the neck (3 per cent). Thus the total area burned was approximately 23 per cent of the body surface. The hands were wrapped with pressure dressings, being maintained in the anatomical position. The remainder of the burned surface was treated by the exposure method.

The patient was returned from surgery to a bed remade with a sterile laparotomy drape sheet. Calculations based on an estimated body weight of 65 kg. and 23 per cent surface area involvement gave the blood, plasma and plasma expander requirements for the first 24 hours as (65 times 23) 1,495 cc., and the same amount of electrolyte solutions

plus 2,000 cc. of 5 per cent glucose. Approximately half of this total of 4,990 cc. was charted for infusion during the next six hours inasmuch as four hours and a half had already elapsed since injury.

Because of previous immunization during service with the armed forces the patient was given 1 cc. tetanus toxoid booster injection.

The first hour after catheterization the urinary secretion was 15 cc. but by the second hour this had risen to 22 cc. and by the sixth hour to 45 cc. Up to this time the patient had received 500 cc. of dextran and 500 cc. of whole blood plus 1,000 cc. of Ringer's lactate and 500 cc. of 5 per cent glucose. During the remainder of the first 24 hours 500 cc. of dextran and 1,000 cc. each of Ringer's lactate and 5 per cent glucose were infused while the urinary output fluctuated between 40 cc. and 60 cc. per hour, showing fluid stabilization.

The patient demonstrated gastrointestinal normality early in the second 24 hours and drank quite freely (2,500 cc.) of the alkaline drink (level teaspoonful each of sodium chloride and sodium bicarbonate per quart of water). Thus with a parenteral supplement of only 500 cc. of whole blood and 1,000 cc. each of Ringer's lactate and 5 per cent glucose, the urinary secretion was maintained at an adequate level. Large parenteral doses of vitamin B complex and vitamin C were added to the electrolyte solution. The daily prophylactic injection of penicillin was administered. On the second day the patient ambulated with minimal discomfort and throughout the day required only mild sedation.

On the third day there was definite urinary stabilization with a moderate tendency to diuresis. Hence the retention catheter was removed. The oral alkaline solution was discontinued and the patient

placed on a high caloric, high protein (nitrogen) diet, with massive oral doses of vitamins, especially the B complex and C.

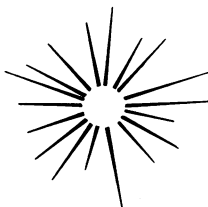
The daily routine laboratory tests performed on the fourth day revealed a decrease in circulating erythrocytes. Hence 500 cc. of blood was administered. The temperature remained normal throughout this 24 hours and there were no signs of gross infection. The prescribed diet supplemented by vitamins was tolerated very well.

The course from this day on was uneventful. Antibiotic therapy was discontinued on the sixth day. The patient was prepared for skin grafting on the twelfth day and the grafting was done three days later.

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WITH WARNING

IMMEDIATELY REPORT TO
YOUR CIVIL DEFENSE
ASSIGNMENT

IF THIS IS NOT POSSIBLE,
REPORT TO THE NEAREST
MEDICAL INSTALLATION

WITHOUT WARNING

TAKE IMMEDIATELY AVAILABLE
COVER. DO NOT LOOK AT THE
BRILLIANT FLASH. IF IN CAR
AND NO SHELTER AVAILABLE,
STOP AT CURB, CLOSE ALL
WINDOWS, TURN CAR RADIO ON,
LIE ON FLOOR OF CAR.

AS SOON AS POSSIBLE CARRY
OUT CIVIL DEFENSE ASSIGN-
MENT.



M. D.

WHAT TO DO ?

KNOW YOUR C.D. ASSIGNMENT. LEARN ALL ABOUT C.D.